Review of Environmental Assessment of WWTP Lagoons

Town of Marion

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November 15, 2011

CDM

Overview

- Overview of WWTP Lagoons
- Review Receiving Water Health
- Discuss findings of HWG Report *Environmental Assessment of the Marion Wastewater Treatment Plant Sewage Lagoon* (April 2011)
- Next Steps

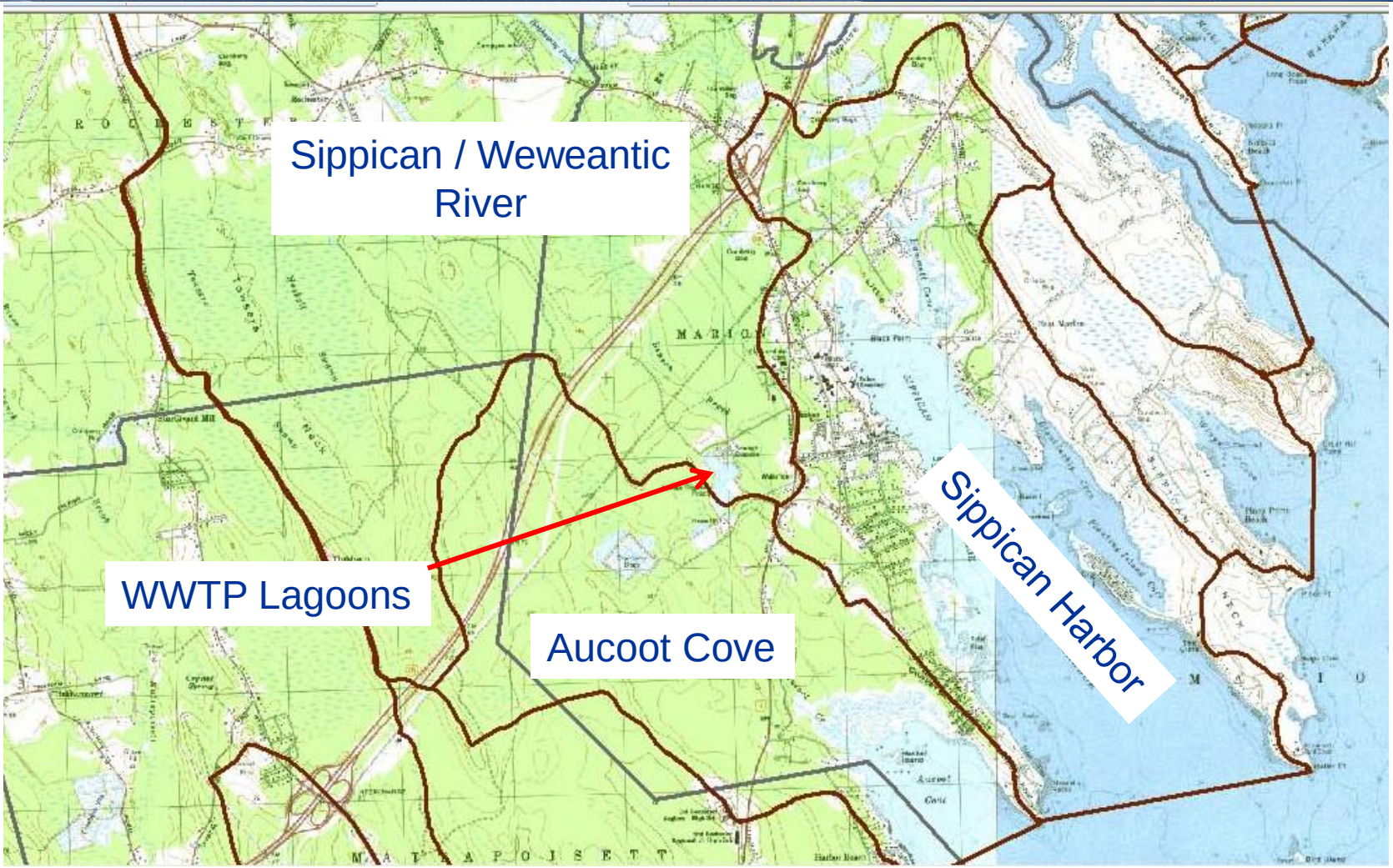
History of Wastewater Treatment in Marion

- 1971 – Facultative lagoons online with sand filters
- 1990s – UV disinfection added
- 2002 – Disk filters replace sand filters
- 2005 – Plant upgraded to provide nutrient removal
  - Screenings and grit removal
  - Sequencing batch reactors (SBR)
  - Disk filters
  - UV disinfection
  - Lagoons used as equalization basin

About the WWTP Lagoons

- 3 lagoons built in early 1970s
- Unlined
- Aerated
- ~20 acres
- Lagoons receive several inflows and integral to new plant operations
  - Untreated wastewater in excess of plant's average-day capacity
    - Function as equalization basins (3 mgd peak flow vs. 1.2 mgd design capacity; significant capital savings)
  - Waste activated sludge from sequencing batch reactors (SBRs)
    - Sludge is not removed from lagoons but degrades naturally
  - Backwash water from disk filters

Marion's Receiving Waters and Subwatersheds defined by Buzzards Bay National Estuaries Program



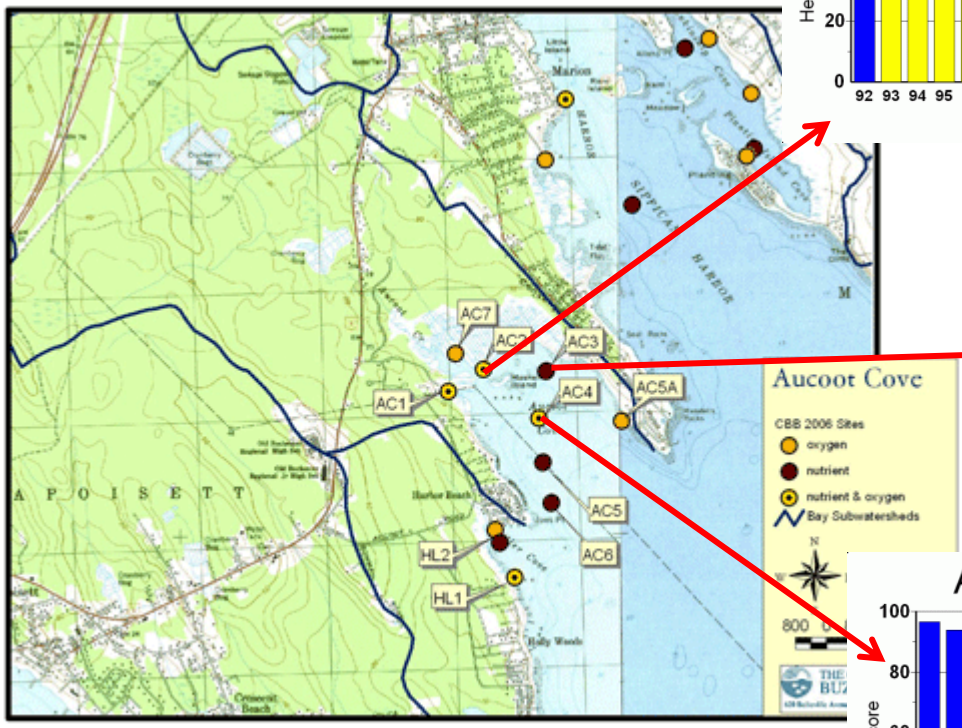
Measures of Health of Coastal Waters: MDEP

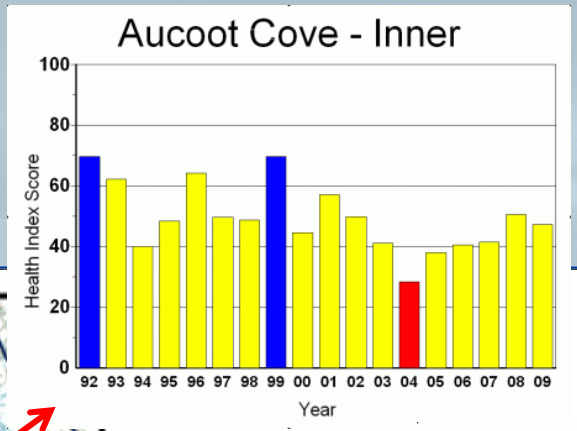
- MDEP's 2010 Integrated List of Waters
  - Meets Uses: Aucoot Cove for shellfishing, primary and secondary recreation
  - Impaired Waters:
    - Inner Aucoot Cove: nitrogen, DO, nutrient/eutrophication indicators, ~~fecal coliform~~
    - Inner Sippican Harbor: nitrogen, nutrient/eutrophication indicators, fecal coliform
    - Weweantic River: nutrients, other habitat alterations, pathogens

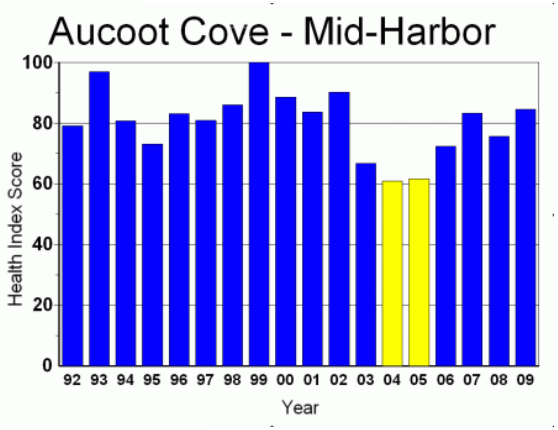
Measures of Health of Coastal Waters: Buzzards Bay Coalition

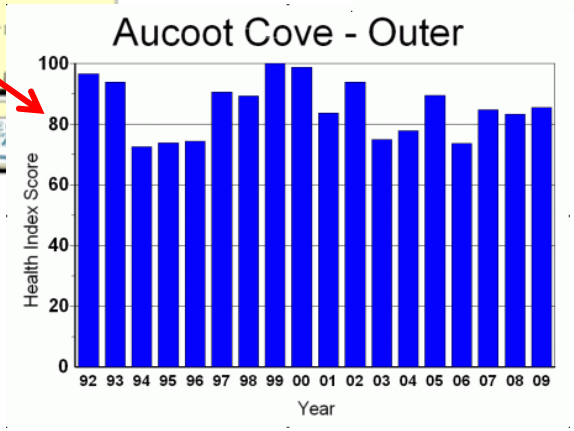
- Sampling collected by BayWatchers (largest citizen voluntary sampling effort in New England)
- Nearly two decades of high quality water quality data
- Used to determine Buzzards Bay Coalition's Bay Health Index; calculated from
  - Mean summertime water clarity
  - Mean summertime phytoplankton (algal) pigments
  - Mean summertime organic nitrogen
  - Lowest 20% of dissolved oxygen concentrations

Aucoot Cove
Bay Health Index

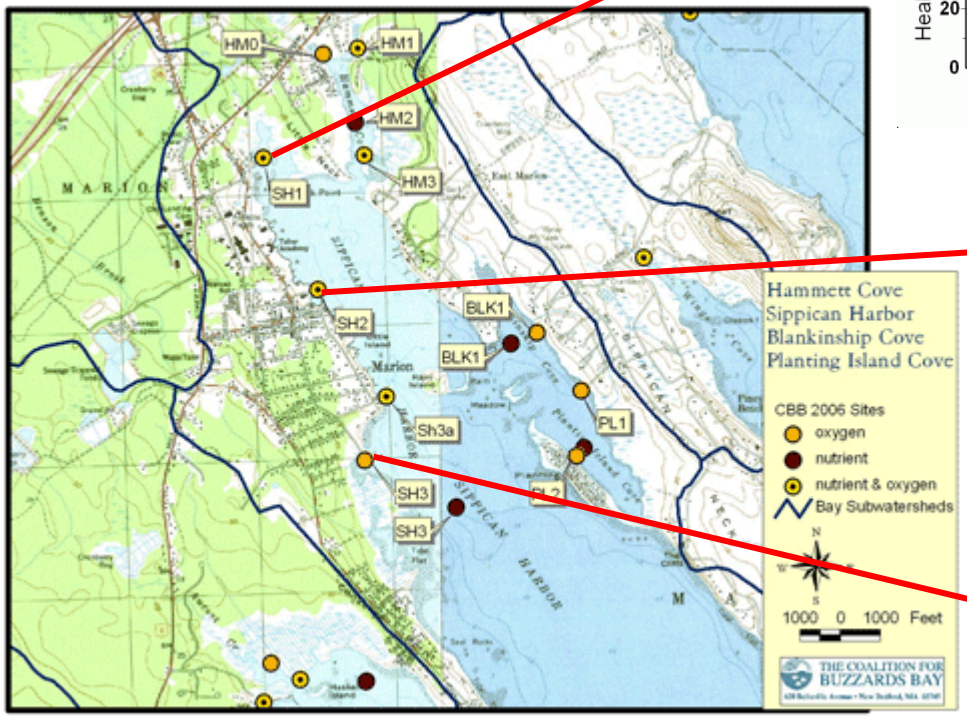


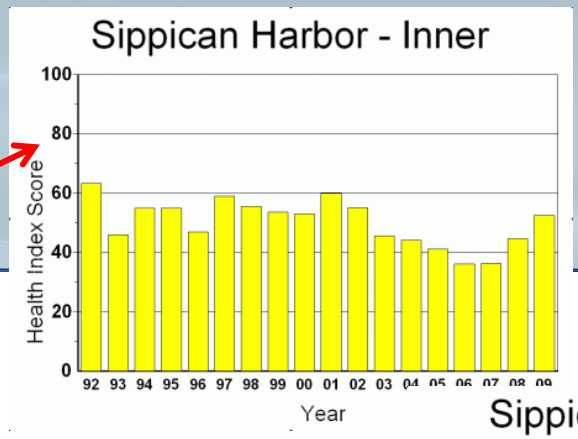


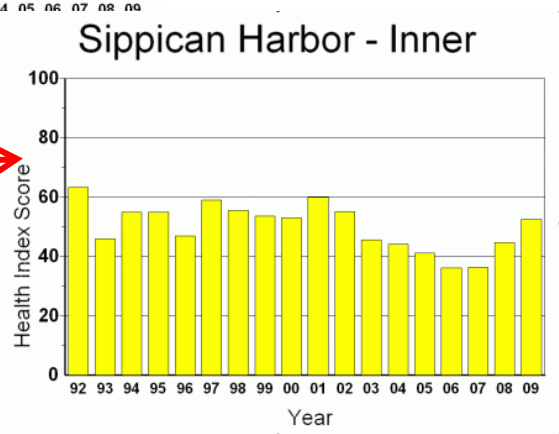


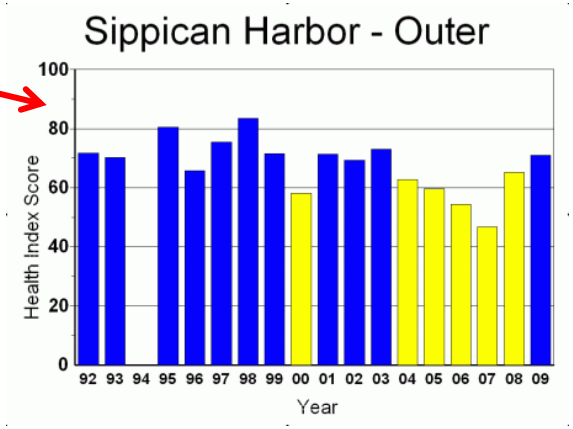


Sippican Harbor
Bay Health Index









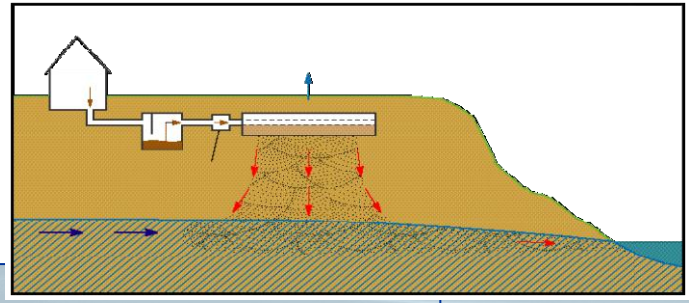
Good to Excellent (65-100)

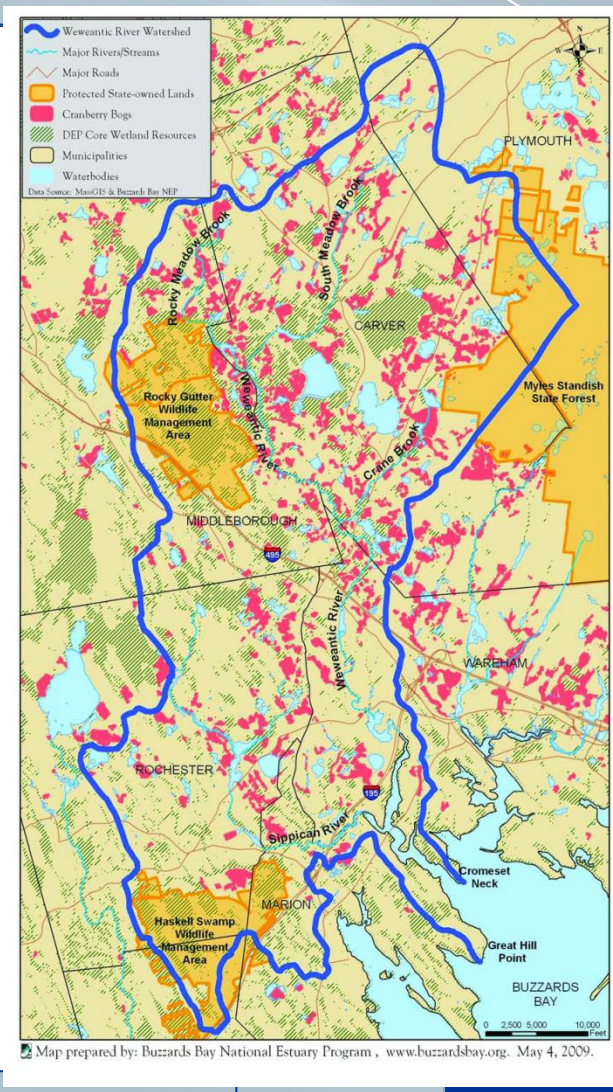
Fair (35-65)

Poor/Eutrophic Conditions(<35)

Sources of Nitrogen to Marion's Coastal Waters

- WWTP treated effluent to Aucoot Cove
- Effluent from on-site septic systems
- Stormwater runoff
- Fertilizers (residential and agricultural)
- Animal wastes
- Boat wastes
- Atmospheric deposition
- Leakage from WWTP lagoons?
- Others?





Overview: *Environmental Assessment of Marion WWTP Sewage Lagoons*

- Commissioned by the Buzzards Bay Coalition
- Prepared by Horsley Whitten Group in April 2011
- Town provided comments in May 2011
- Presentation to citizens by HW in May 2011

Environmental Assessment of Marion WWTP Sewage Lagoons: Objectives and Scope

- Objective: determine if leakage of untreated effluent from the base of WWTP lagoons have potential impacts to groundwater and nearby coastal estuaries.
- Tasks:
  - Installed monitoring wells and staff gages
  - Collected water level and water quality data
  - Mapped water table to analyze local geological and groundwater conditions

Report's Key Assumptions

- Leakage rate from lagoons = 1 inch per day
- Nitrogen concentration leaking from lagoons is 20 mg/l
- Groundwater flow direction determined from levels at 5 surface water stations and nine wells

Report's Findings

- Infiltation from lagoons appears to reach underlying groundwater
- Lagoons are located on groundwater mound, thus radial flow is
  - 50% to Aucoot Cove
  - 30% to Sippican Harbor
  - 20% to Benson Brook → Sippican/Weweantic River
- Estimated leakage from lagoons ~0.5 mgd and 33,400 lb nitrogen
- Recommendations
  - Lagoons are a significant source of nitrogen and should be lined
  - Reduce infiltration to sewer system and reduce needed lagoon volume
  - Consider permeable reactive barriers to reduce N before reaching harbors

Summary: Observations on Report's Findings

- Leakage rate appears to be overestimated
- Nitrogen in waters vicinity of WWTP reflects development
- Nitrogen load to groundwater from lagoons appears to be overestimated
- Groundwater travel times and ultimate receiving water should be reconsidered
- Nitrogen load reaching receiving waters appears to be overestimated
- Other sources of nitrogen not considered thus importance of potential lagoon leakage unknown
- Need additional information to prioritize expenditures for restoring receiving waters

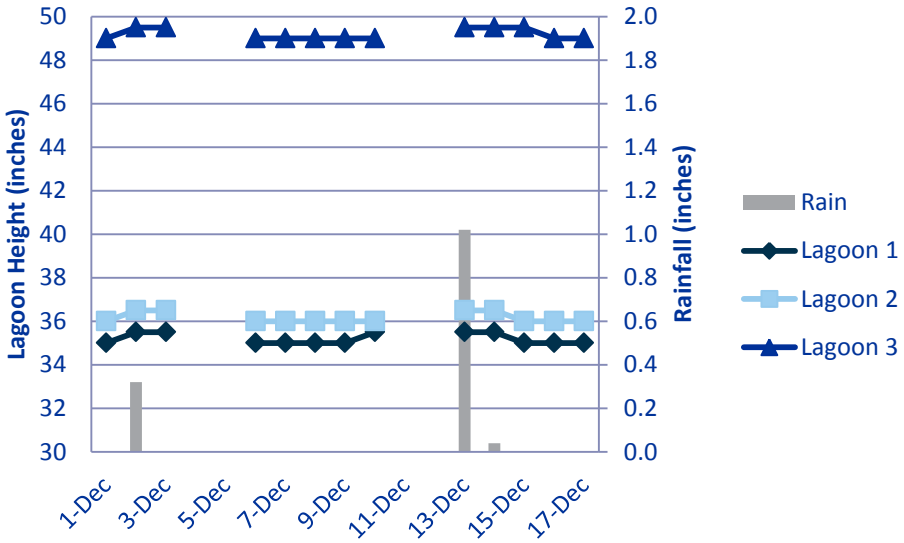
1. Leakage Rate Appears to be Overestimated

HW Assumption: Leakage rate = 1 inch/day

This is the same as plant inflow

- 1 inch/day over 20 acres of lagoons = 0.543 mgd
- 2010 average daily plant inflow = 0.533 mgd

Records of water level in lagoons do not show this leakage



Representative 2010 lagoon levels when no significant flows to or from lagoons

2. Nitrogen Measurements in Vicinity of WWTP Reflect Development in Area

- Nitrogen in groundwater ranged from <0.23 mg/l to 10.2 mg/l, and averaged 1.8 mg/l,
  - → typical of areas with development
- Nitrogen typically varied 3 to 5 times across three sampling dates;
  - → Variability seems high if hypothesis is constant load from WWTP lagoons
- Other possible sources in area not considered
  - → Landfill, transfer station and composting occur adjacent to WWTP
- Two samples taken on Effluent Brook; downstream samples had higher nitrogen concentration
  - → Other sources of nitrogen in area southeast of WWTP

Date	Upstream	Downstream
May 2010	0.58 mg/l	2.21 mg/l
August 2010	1.18 mg/l	2.87 mg/l
February 2011	0.73 mg/l	2.68 mg/l

3. Nitrogen Load to Groundwater from Lagoons Appears to be Overestimated

- Assumptions/Findings
  - Load to groundwater = leakage rate (1”/d) times 20 mg/l T Nitrogen
  - Calculated load = 33,400 pounds nitrogen per year
  - Load is equivalent to 1,965 homes on septic systems
- Observations
  - Some nitrogen reduction in lagoons as bottom sludge will have no oxygen (bacteria transform nitrate to nitrogen gas)
  - Only 1,700 homes in Marion (*U.S. Census 2005-09*), and not all sewered
  - Estimated load leaked through bottom of lagoons approximately the same as plant influent, yet most plant influent does not reach lagoons

4. Groundwater Travel Times and Ultimate Receiving Waters Should be Reconsidered

- Groundwater contours and travel time analysis assumes groundwater is not intercepted by streams and wetlands
- Analysis assumes groundwater from WWTP vicinity reaches Sippican Harbor
  - Groundwater flow is complicated in this area as is headwaters for all three of Marion's receiving waters.
  - Based on topographic divide and stream placement, we believe groundwater flow will not reach Sippican Harbor
  - Would need to be confirmed with additional groundwater wells
- Report suggests travel time to Sippican Harbor matches increasing nitrogen concentrations there; but does allow there are other sources of nitrogen to harbor.

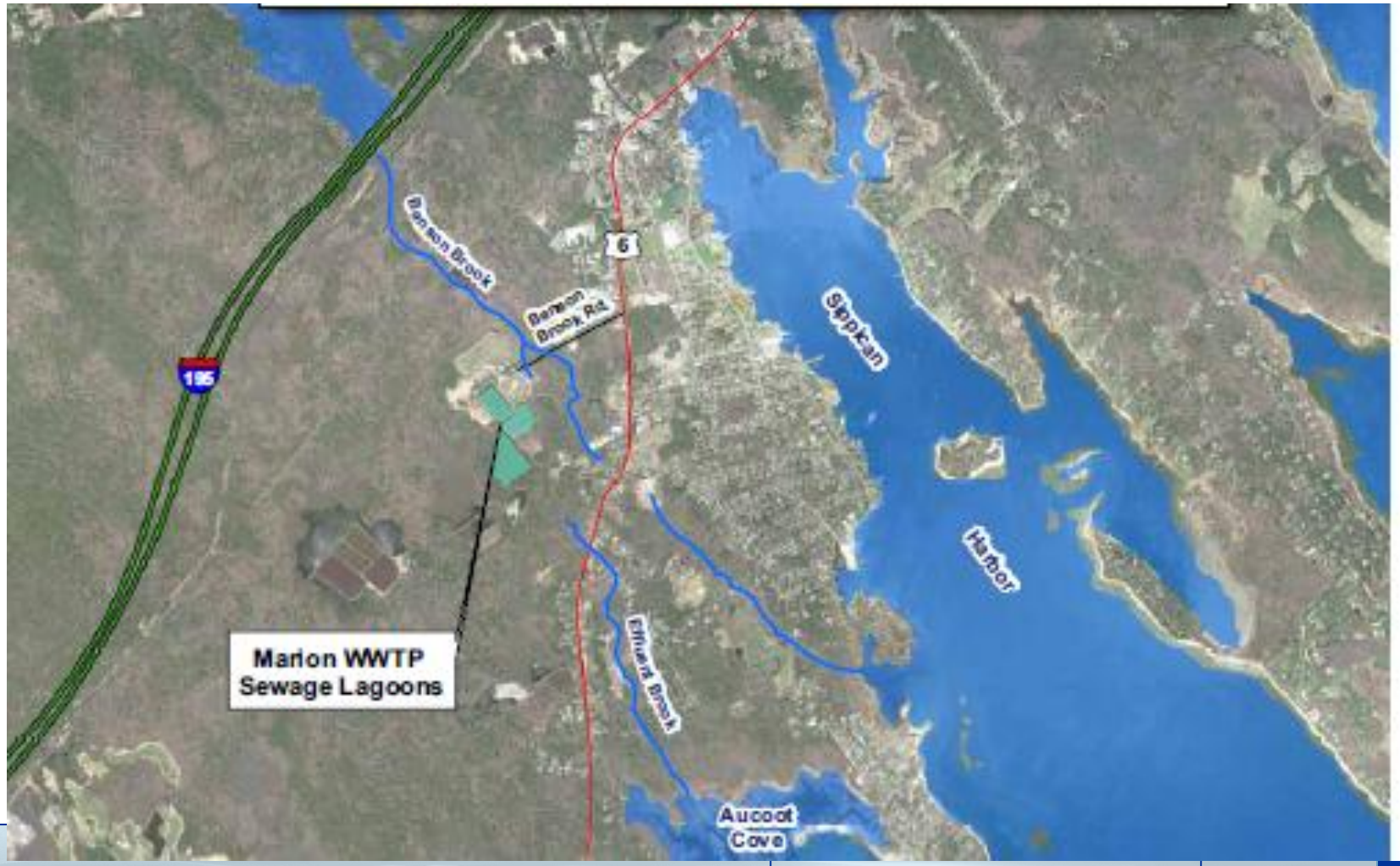
5. Nitrogen Load Reaching Receiving Waters appears to be Overestimated

- Report suggests that all of the nitrogen in the groundwater will reach Marion's receiving waters
- Report does not account for interception groundwater and attenuation of nitrogen through
  - Numerous swamps/marshes/ponds
  - Saltwater marsh at head of Aucoot Cove

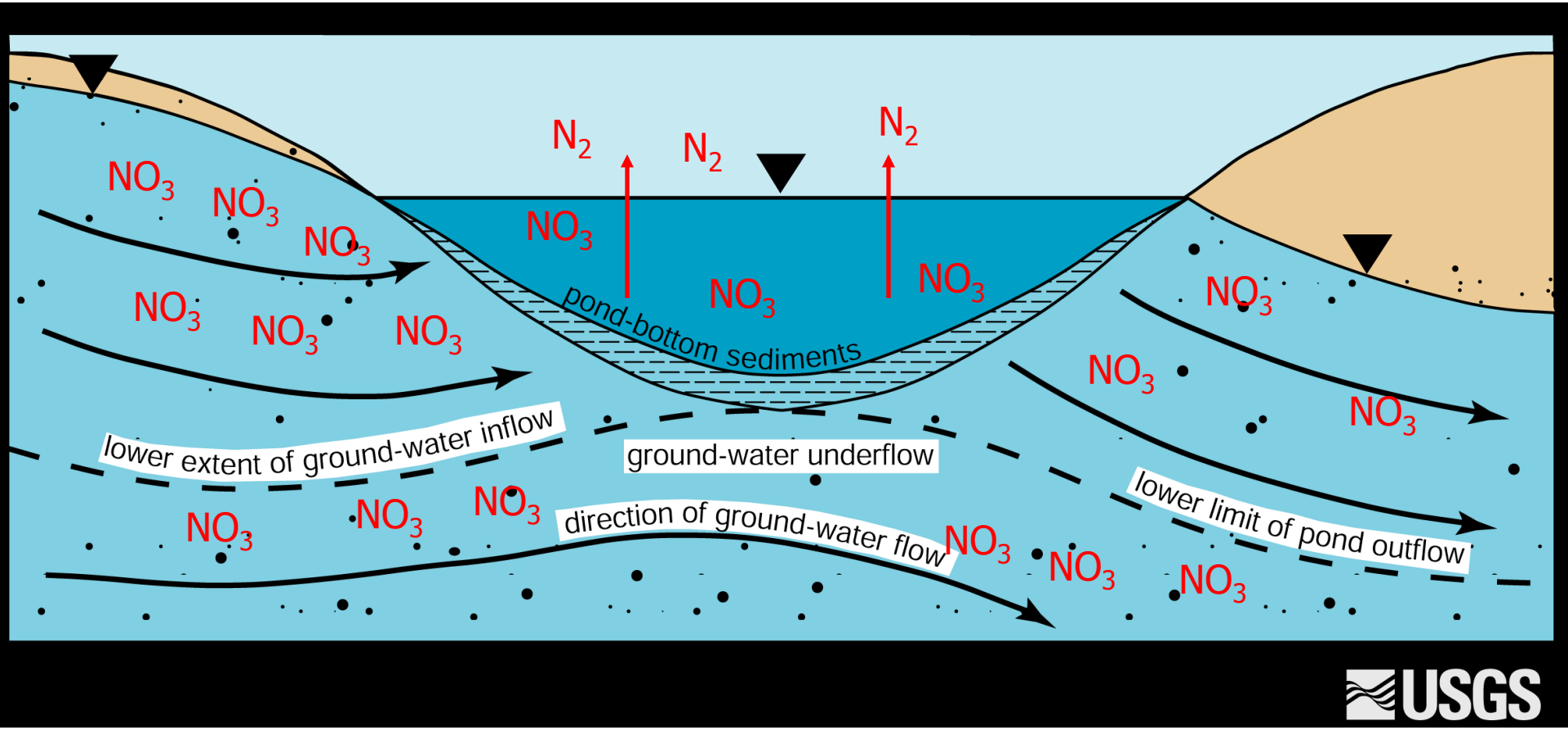
Next Steps

- Conduct mass balance on treatment plant and lagoons to better estimate potential leakage
- Refine estimates of nitrogen that could reach groundwater
- Refine estimates of nitrogen that could reach receiving waters
- Estimate other sources of nitrogen to receiving waters to put potential WWTP lagoon contributions in context

Extra slides below here


Benson Brook
Benson Brook Rd.
6
195
Sippican
Harbor
Effluent Brook
Aucoot Cove
Marion WWTP
Sewage Lagoons

Nitrogen Attenuation: Ground Water Flow-Through Pond



Why Protect Our Water Resources?

	Groundwater	Estuaries	Coasts	Ponds
Drinking water source	☑			
Public health	☑	☑	☑	☑
Recreation		☑	☑	☑
Ecological health	☑	☑	☑	☑
Economic vitality	☑	☑	☑	☑
Address DEP regulatory requirements		☑	☑	☑